US009099907B2

(12) **United States Patent**
Chang et al.

(10) **Patent No.: US 9,099,907 B2**
(45) **Date of Patent: Aug. 4, 2015**

(54) **MOTOR STATOR AUTOMATICALLY ASSEMBLING METHOD**

(71) Applicant: **Genese Intelligent Technology Co., Ltd.**, Kaohsiung (TW)

(72) Inventors: **Nai-Hsin Chang**, Kaohsiung (TW); **Jung-Pei Huang**, Kaohsiung (TW)

(73) Assignee: **Genese Intelligent Technology Co., Ltd.**, Kaohsiung (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/166,951**

(22) Filed: **Jan. 29, 2014**

(65) **Prior Publication Data**

US 2014/0182117 A1 Jul. 3, 2014

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/409,462, filed on Mar. 1, 2012.

(30) **Foreign Application Priority Data**

Oct. 28, 2011 (TW) ..... 100220282 U
Feb. 4, 2013 (TW) ..... 102104272 A

(51) **Int. Cl.**
H02K 15/00 (2006.01)
H02K 15/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H02K 15/022*** (2013.01); ***H02K 15/00*** (2013.01); ***H02K 15/0442*** (2013.01); ***H02K 15/066*** (2013.01); *H02K 2203/03* (2013.01); *Y10T 29/49009* (2015.01); *Y10T 29/53143* (2015.01)

(58) **Field of Classification Search**
CPC Y10T 29/49009; Y10T 29/53143; Y10T 29/49073; Y10T 29/49071; Y10T 29/53152; H02K 3/28; H02K 3/12; H02K 3/345; H02K 15/0056; H02K 3/30; H02K 15/00; H02K 3/52
USPC 29/596, 598, 605, 606, 732, 734, 735
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,702,498 A * 11/1972 Mason 29/596
7,011,266 B2 * 3/2006 Hashimoto et al. 242/433.4
(Continued)

FOREIGN PATENT DOCUMENTS

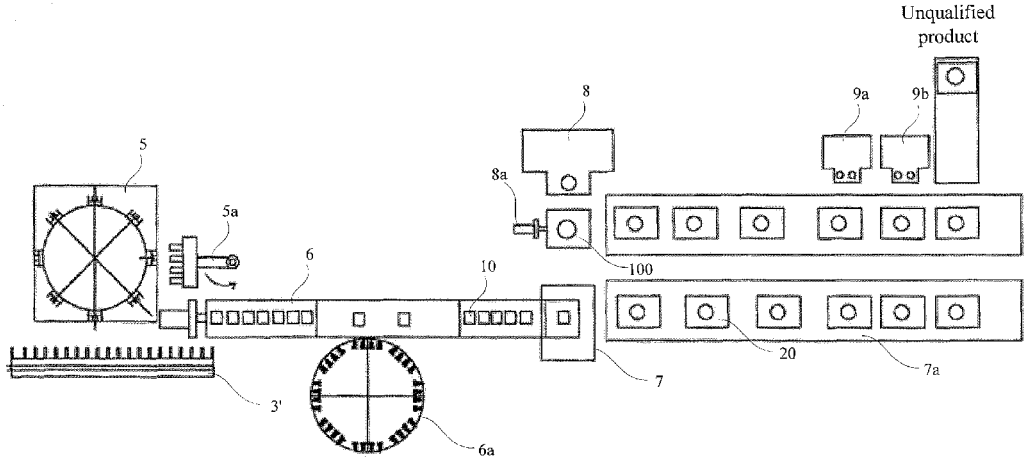
TW M335869 7/2008

Primary Examiner — Thiem Phan
(74) *Attorney, Agent, or Firm* — Alan D. Kamrath; Kamrath IP Lawfirm, P.A.

(57) **ABSTRACT**

A motor stator automatically assembling system includes a feeding unit, a wire-winding unit, a first conveyer unit, a second conveyer unit, a first assembly unit and a second assembly unit. A motor stator automatically assembling method includes: the feeding unit is operated to feed a plurality of insulation members; the insulation members are arranged on the first conveyer unit to convey to the wire-winding unit; the wire-winding unit is operated to wind wires on the insulation members to form a plurality of wire-wound insulation members; the wire-wound insulation members are arranged on the second conveyer unit to convey to the first assembly unit; the first assembly unit is operated to insert pole teeth into the wire-wound insulation members to form a plurality of compact pole tooth sets; the second assembly unit is operated to combine the compact pole tooth sets with a stator ring frame to form an assembled motor stator.

20 Claims, 10 Drawing Sheets



(51) **Int. Cl.**
H02K 15/04 (2006.01)
H02K 15/06 (2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,064,470	B2	6/2006	Yokoyama et al.	
7,367,106	B2 *	5/2008	Becherucci et al.	29/596
7,646,127	B2	1/2010	Fujii et al.	
2004/0021393	A1	2/2004	Suzuki et al.	
2007/0024149	A1	2/2007	Nagata et al.	
2008/0143210	A1	6/2008	Wang et al.	
2009/0127964	A1	5/2009	Yumoto et al.	
2009/0315428	A1	12/2009	Chou et al.	
2010/0019592	A1	1/2010	Altindis	
2012/0119606	A1	5/2012	Chen et al.	

* cited by examiner

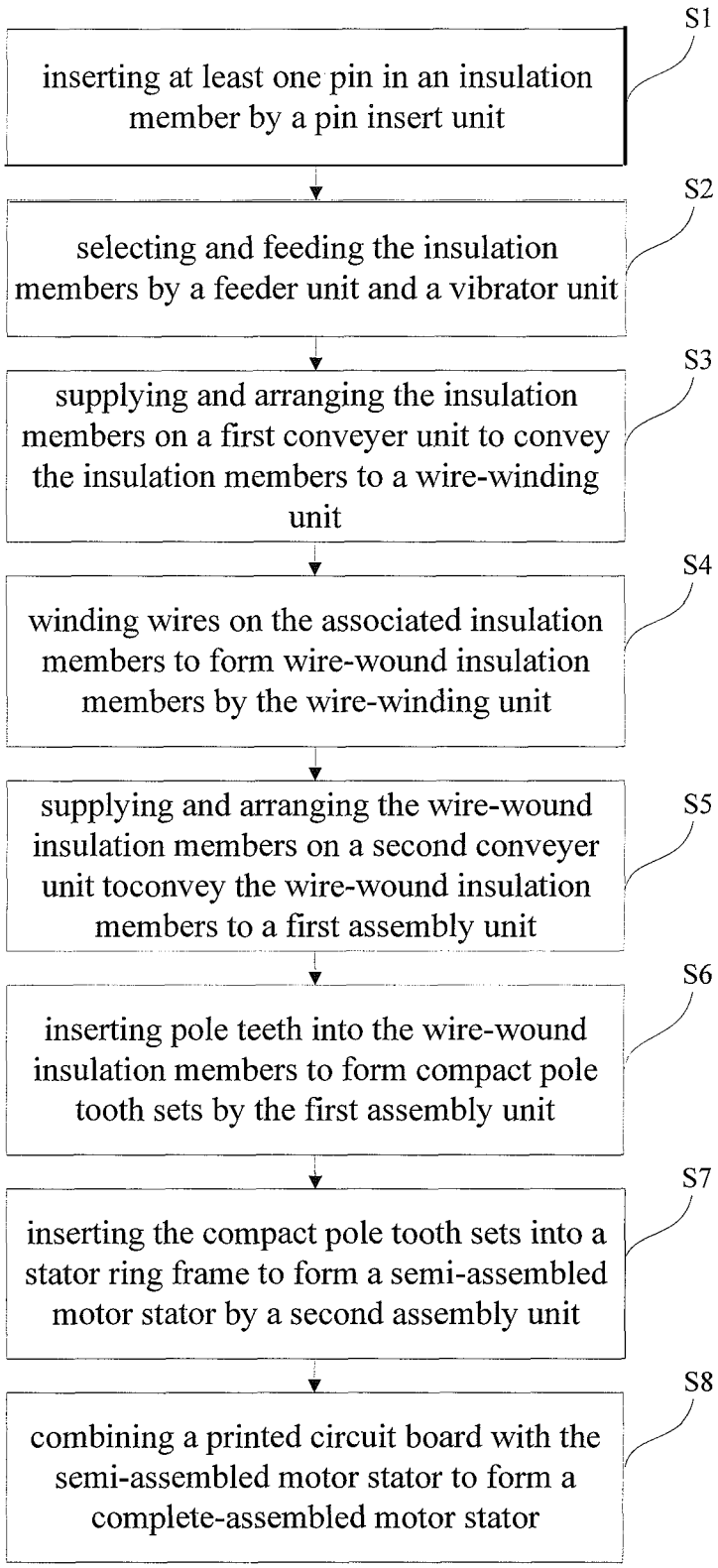

S1
inserting at least one pin in an insulation member by a pin insert unit
S2
selecting and feeding the insulation members by a feeder unit and a vibrator unit
S3
supplying and arranging the insulation members on a first conveyer unit to convey the insulation members to a wire-winding unit
S4
winding wires on the associated insulation members to form wire-wound insulation members by the wire-winding unit
S5
supplying and arranging the wire-wound insulation members on a second conveyer unit toconvey the wire-wound insulation members to a first assembly unit
S6
inserting pole teeth into the wire-wound insulation members to form compact pole tooth sets by the first assembly unit
S7
inserting the compact pole tooth sets into a stator ring frame to form a semi-assembled motor stator by a second assembly unit
S8
combining a printed circuit board with the semi-assembled motor stator to form a complete-assembled motor stator

FIG. 1

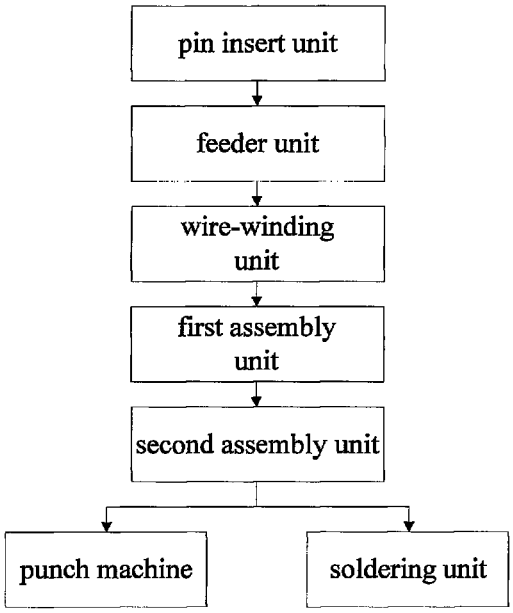

pin insert unit
feeder unit
wire-winding unit
first assembly unit
second assembly unit
punch machine
soldering unit

FIG. 1A

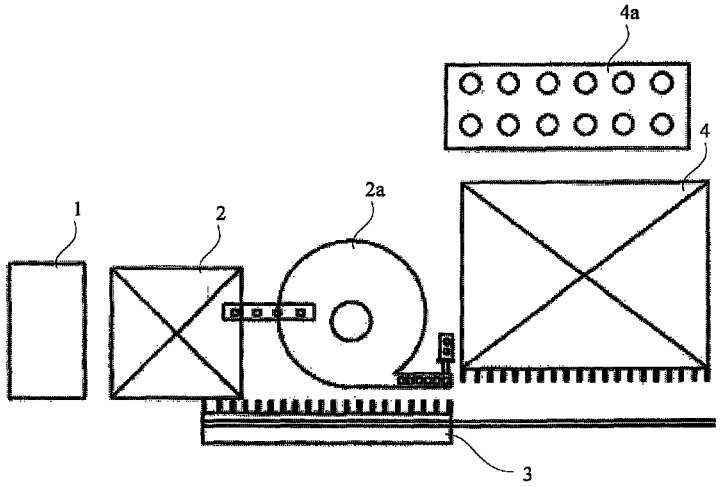

4a
4
1
2
2a
3

FIG. 2A

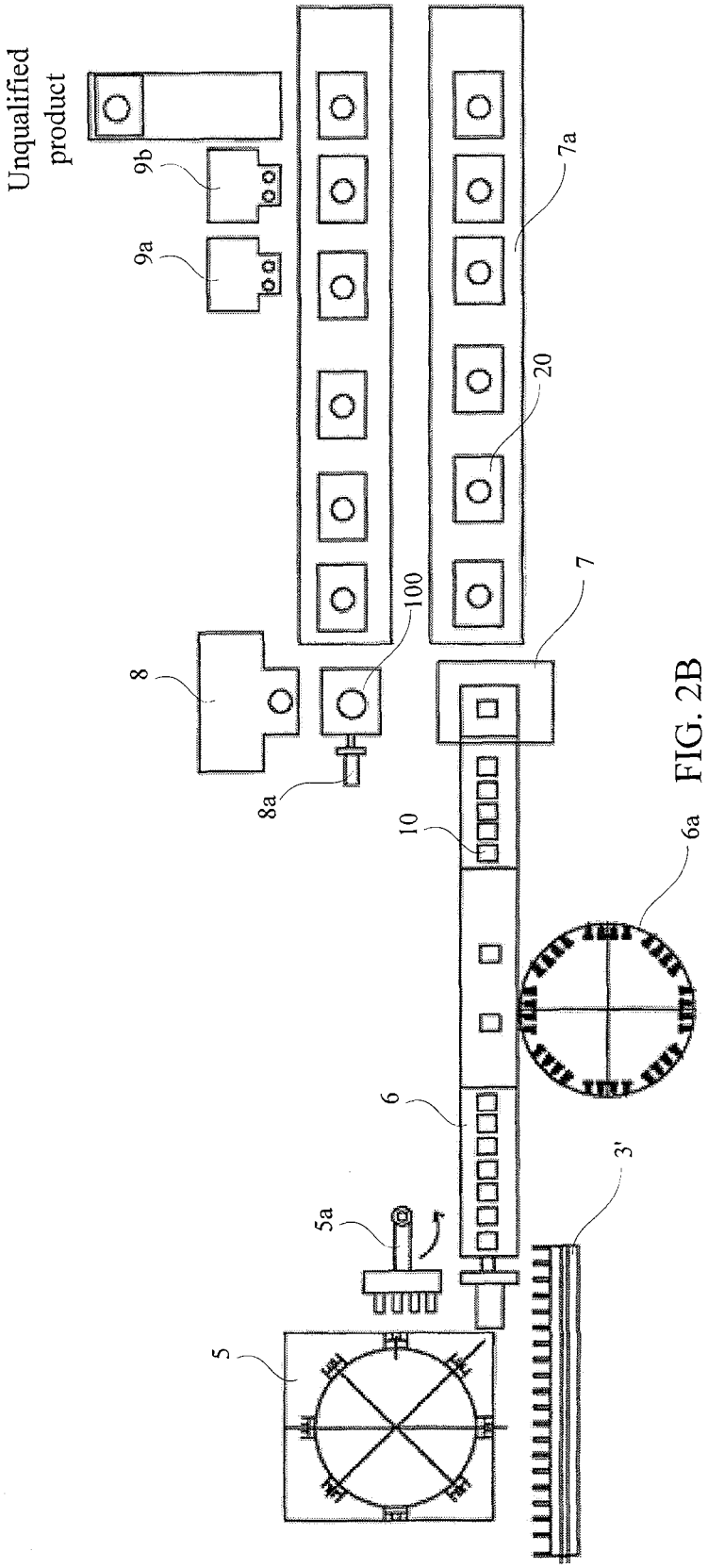


FIG. 2B

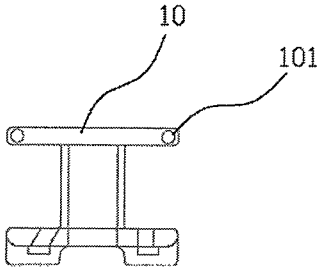


FIG. 3

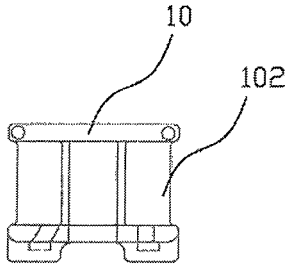


FIG. 4

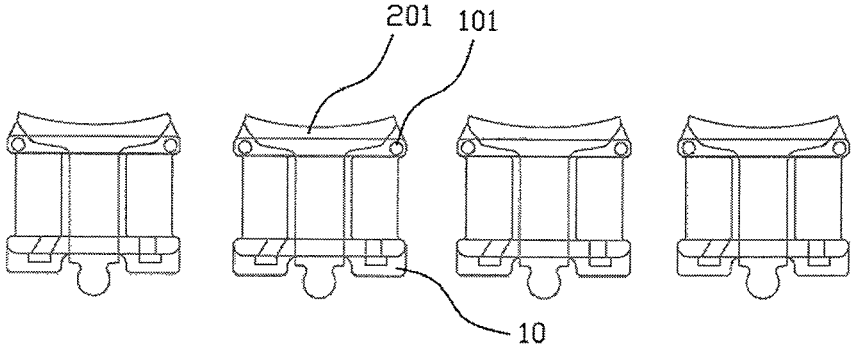


FIG. 5

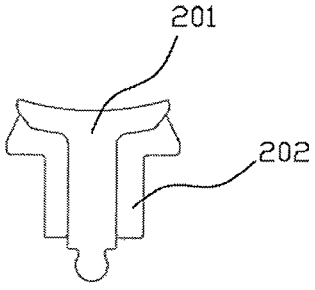


FIG. 5a

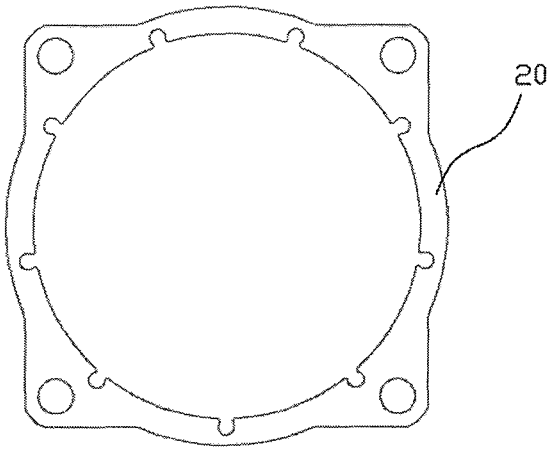


FIG. 6

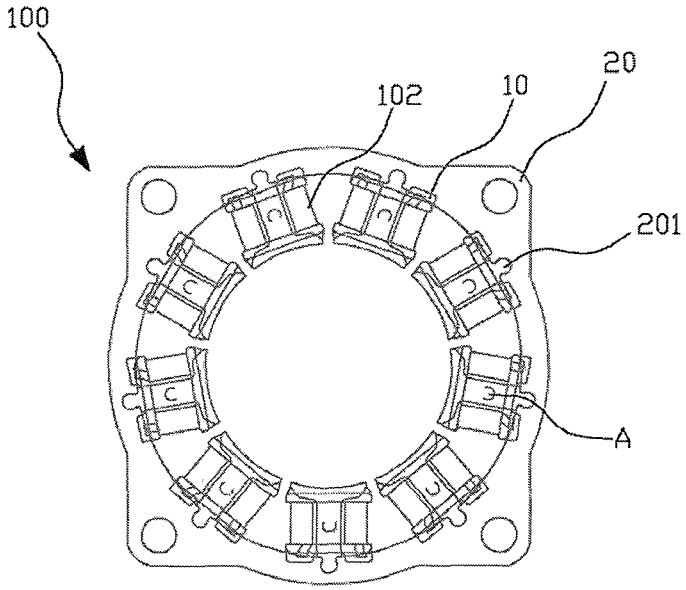


FIG. 7

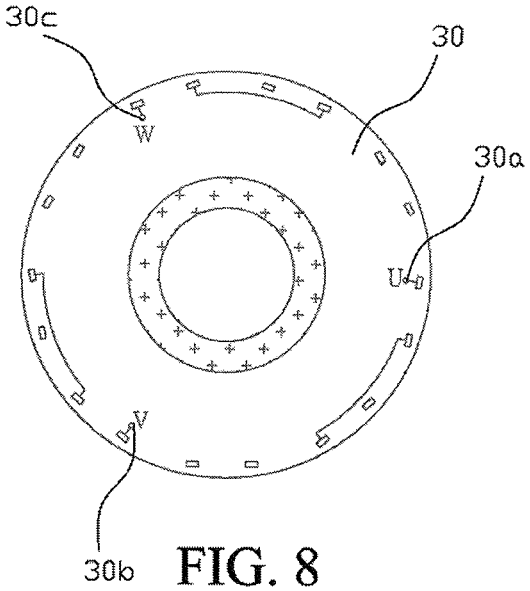


FIG. 8

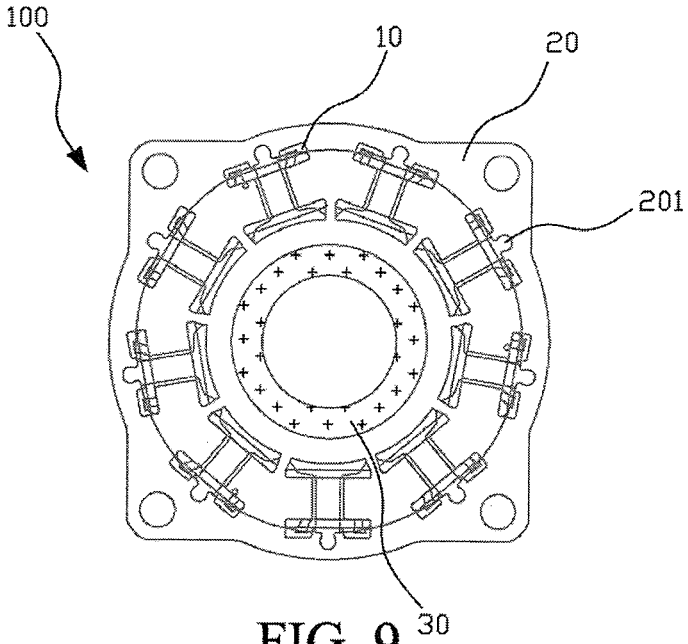


FIG. 9

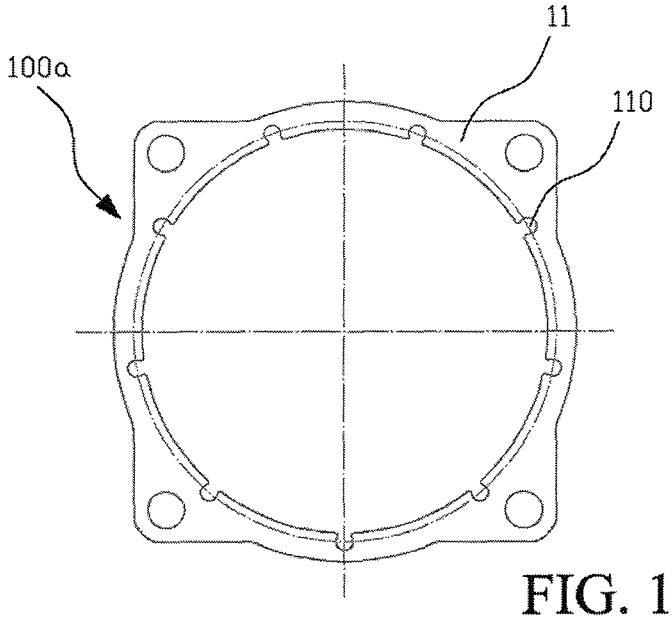


FIG. 10

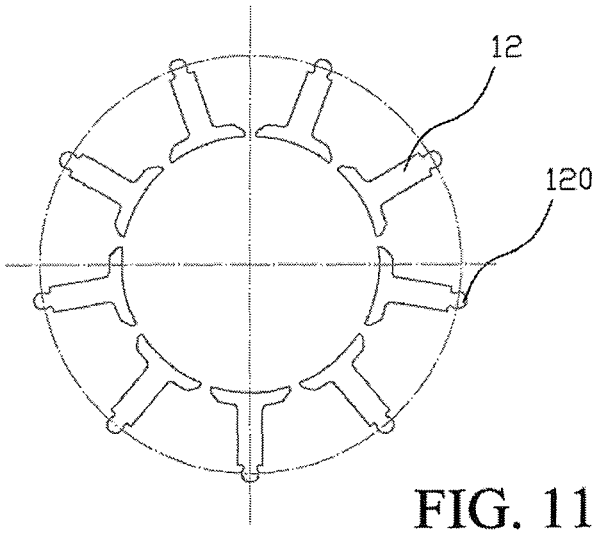


FIG. 11

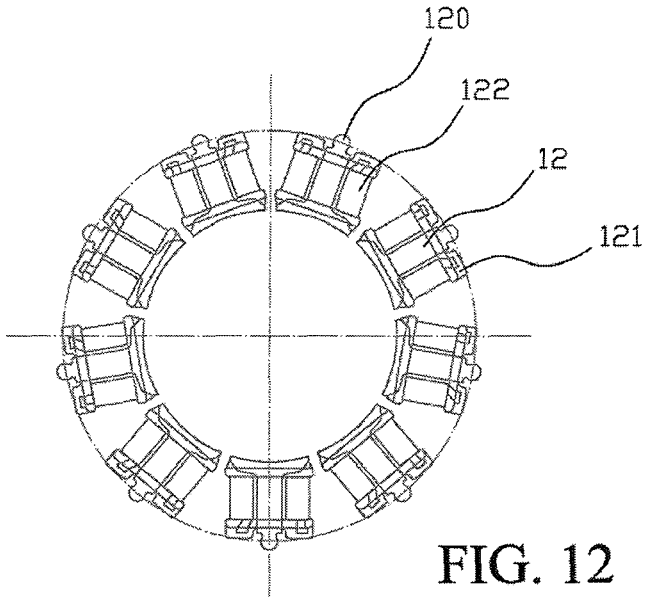


FIG. 12

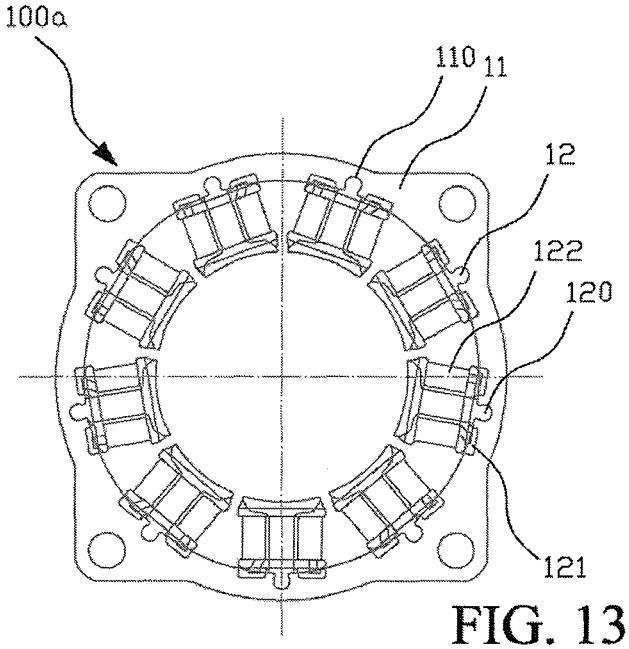


FIG. 13

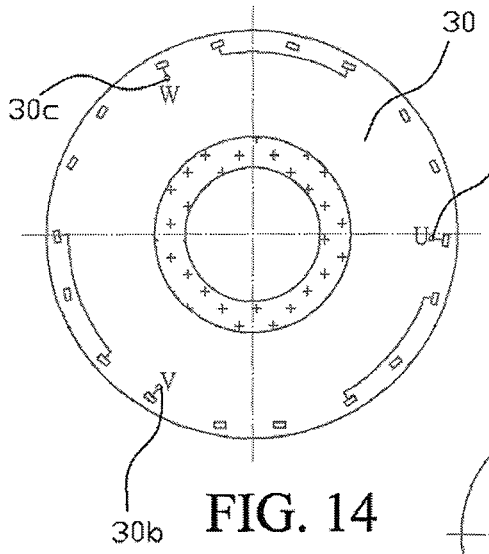


FIG. 14

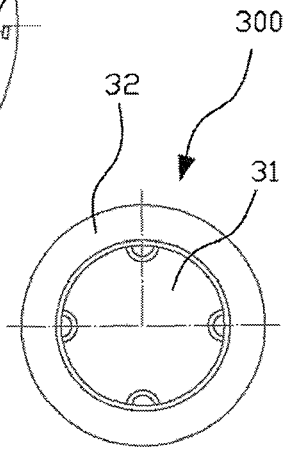


FIG. 15

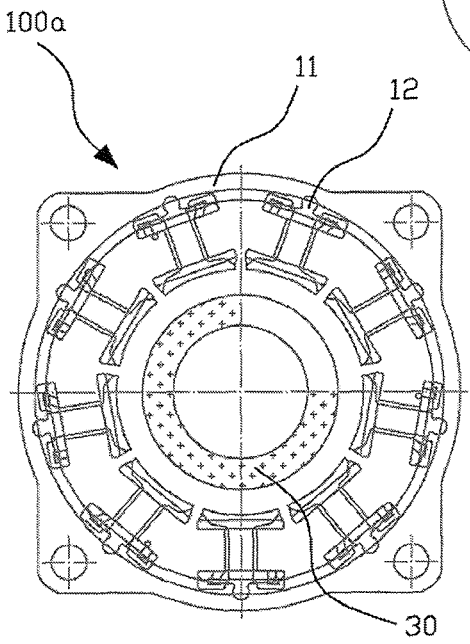


FIG. 16

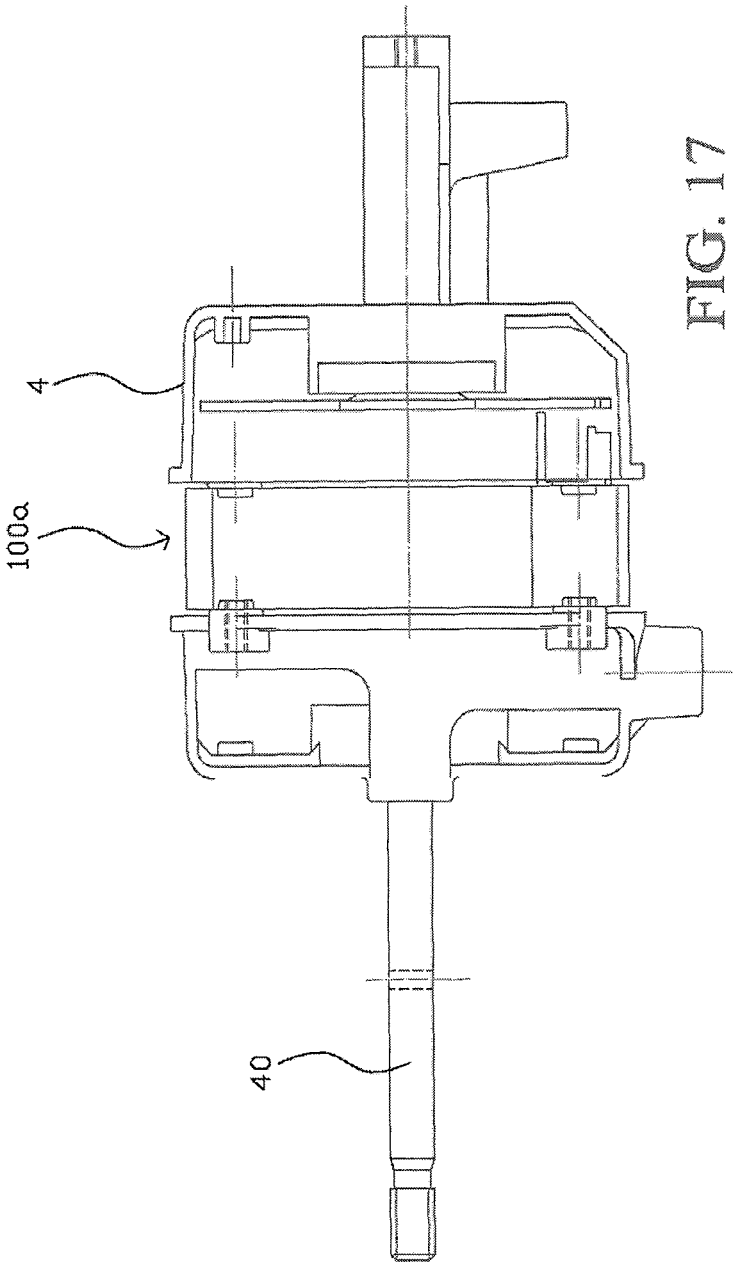


FIG. 17

MOTOR STATOR AUTOMATICALLY ASSEMBLING METHOD

This application is a continuation-in-part of U.S. patent application Ser. No. 13/409,462, filed Mar. 1, 2012, which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a motor stator automatically assembling system, assembly line and assembling method thereof. More particularly, the present invention relates to the motor stator automatically and continuously assembling system, assembly line and assembling method thereof.

2. Description of the Related Art

Taiwanese Patent Application Publication No. 201220649, entitled "Motor stator and assembling method thereof," discloses a motor stator including a stator unit and an auxiliary inductive unit. The stator unit includes a PCB substrate and a plurality of inductive coils which are equi-spaced apart and embedded in the PCB substrate. The auxiliary inductive unit includes an insulation member, a magnetically conductive member and at least one winding set. The insulation member is arranged on the PCB substrate and the magnetically-conductive member is arranged on the insulation member. The winding is combined with the magnetically conductive member, the insulation member and the PCB substrate. The winding includes a pillar member and an auxiliary coil wound thereon. The pillar member extends through the magnetically conductive member, the insulation member and the PCB substrate. The pillar member with the coil wound protrudes into the PCB substrate so as to increase the number of total turns of each coil or the total number of poles deployed on the stator unit, thereby improving the magnetically driving force of the motor stator.

However, the assembling method of the motor stator applied in TWN Patent Appl. Pub. No. 201220649 is not an automatically assembling method. Hence, there exists a need of providing an automatically assembling method for the conventional motor stator. The above-mentioned patent is incorporated herein by reference for purposes including, but not limited to, indicating the background of the present invention and illustrating the state of the art.

As is described in greater detail below, the present invention provides a motor stator automatically assembling system and method thereof. A plurality of automatic assembly units and a plurality of conveyer units are provided in an assembly line to automatically assemble and convey motor stator components to form an assembled motor stator in such a way as to mitigate and overcome the above problem.

SUMMARY OF THE INVENTION

The primary objective of this invention is to provide a motor stator automatically assembling system and method thereof. A plurality of automatic assembly units and a plurality of conveyer units are connected to form an automatically assembly line along which to automatically assemble motor stator components step by step for forming a semi-assembled motor stator to a completely-assembled motor stator. Accordingly, the motor stator automatically assembling system and method of the present invention is successful in providing an automatically manufacturing process of the motor stator.

The motor stator automatically assembling method in accordance with an aspect of the present invention includes the steps of:

selecting and feeding insulation members by a feeder unit and a vibrator unit;

supplying and arranging the insulation members on a first conveyer unit which conveys the insulation members to a wire-winding unit;

winding at least one wire on the associated insulation member to form wire-wound insulation members by the wire-winding unit;

supplying and arranging the wire-wound insulation members on a second conveyer unit which conveys the wire-wound insulation members to a first assembly unit;

inserting pole teeth into the wire-wound insulation members to form a plurality of compact pole tooth sets by the first assembly unit; and

inserting the compact pole tooth sets into a predetermined stator ring frame to form a semi-assembled motor stator by a second assembly unit.

In a separate aspect of the present invention, the motor stator automatically assembling method further includes the step of: prior to selecting and feeding the insulation members, inserting at least one pin in the insulation member by a pin insert unit.

In a further separate aspect of the present invention, the motor stator automatically assembling method further includes the step of: while winding wires on the insulation members, further winding the wires on the associated pin to electrically connect therewith.

In yet a further separate aspect of the present invention, the motor stator automatically assembling method further includes the steps of: moistening the pins of the wire-wound insulation members with solder paste, soldering the pins with the wires, bending the pins to form a bent portion, executing an impedance or insulation test on the wire-wound insulation members by a first test equipment and combination thereof.

In yet a further separate aspect of the present invention, the pole teeth are provided in a feed magazine from which to insert the stacked pole teeth into the wire-wound insulation members.

In yet a further separate aspect of the present invention, the motor stator automatically assembling method further includes the steps of: supplying the stator ring frame to second assembly unit by a third conveyer unit.

In yet a further separate aspect of the present invention, the motor stator automatically assembling method further includes the steps of: rotating the stator ring frame with respect to the second assembly unit by a rotary unit, thereby inserting each of the pole tooth sets into the stator ring frame.

In yet a further separate aspect of the present invention, the motor stator automatically assembling method further includes the steps of inserting the pins of the semi-assembled motor stator in a printed circuit board, thereby combining the semi-assembled motor stator with the printed circuit board to form a complete-assembled motor stator, and further bending the pins, moistening the pins with solder paste and soldering the pins with the printed circuit board.

In yet a further separate aspect of the present invention, the motor stator automatically assembling method further includes the steps of: punching at least one surface of the semi-assembled motor stator to form at least one recession which is formed to combine the pole teeth each other or to combine the pole tooth sets with the stator ring frame so as to reinforce the structure of the semi-assembled motor stator.

In yet a further separate aspect of the present invention, the motor stator automatically assembling method further

includes the steps of: executing a power test, a resistance test, a dielectric withstand voltage test, an insulation shock test or a load test on the complete-assembled motor stator by a second test equipment.

The motor stator automatically assembling system in accordance with another aspect of the present invention includes:

a feeder unit provided to feed a plurality of insulation members;

a first conveyer unit connecting to the feeder unit to receive the insulation members therefrom, the first conveyer unit operated to arrange the insulation members thereon and to convey the insulation members from the feeder unit;

a wire-winding unit connecting to the first conveyer unit to receive the insulation members therefrom, the wire-winding unit operated to wind wires on the insulation members to form a plurality of wire-wound insulation members;

a second conveyer unit connecting to the wire-winding unit to receive the wire-wound insulation members therefrom, the second conveyer unit operated to arrange the wire-wound insulation members thereon and to convey the wire-wound insulation members from the wire-winding unit;

a first assembly unit connecting to the second conveyer unit to receive the wire-wound insulation members therefrom, the first assembly unit operated to insert pole teeth into the wire-wound insulation members to form a plurality of compact pole tooth sets; and

a second assembly unit operated to insert the compact pole tooth sets into a predetermined stator ring frame to form a semi-assembled motor stator.

In a separate aspect of the present invention, the feeder unit further includes a vibrator unit which is operated to select the insulation members prior to feeding.

In a further separate aspect of the present invention, further including a pin insert unit which is operated to insert at least one pin in the insulation member.

In yet a further separate aspect of the present invention, further including a third conveyer unit connected between the first assembly unit and the second assembly unit, the third conveyer unit operated to convey the compact pole tooth sets to the second assembly unit.

In yet a further separate aspect of the present invention, further including a fourth conveyer unit which is operated to convey the stator ring frame to the second assembly unit.

In yet a further separate aspect of the present invention, further including a soldering unit which is operated to solder the pins to form a plurality of coil sets.

In yet a further separate aspect of the present invention, further including a first test equipment unit which is operated to execute an impedance or insulation test on the wire-wound insulation members.

In yet a further separate aspect of the present invention, further including a second test equipment unit which is operated to execute a power test, a resistance test, a dielectric withstand voltage test, an insulation shock test or a load test on the complete-assembled motor stator.

Further scope of the applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various modifications will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

FIG. **1** is a flow chart of a motor stator automatically assembling method in accordance with a preferred embodiment of the present invention.

FIG. **1**A is a block of a motor stator automatically assembly line in accordance with a preferred embodiment of the present invention.

FIGS. **2**A and **2**B are fragmentally schematic views of first and second portions of a motor stator automatically assembling system in accordance with a preferred embodiment of the present invention.

FIG. **3** is a schematic view of an insulation member applied in the present invention.

FIG. **4** is a schematic view of the wire-wound insulation member manufactured by the motor stator automatically assembling system and method in accordance with the preferred embodiment of the present invention.

FIG. **5** is a schematic view of compact pole tooth sets assembled by the motor stator automatically assembling system and method in accordance with the preferred embodiment of the present invention.

FIG. **5***a* is a schematic cross-sectional top view of a feed magazine and stacked pole teeth provided therein applied in the present invention.

FIG. **6** is a schematic view of a stator ring frame applied in the present invention.

FIG. **7** is a schematic view of a semi-assembled motor stator assembled by the motor stator automatically assembling system and method in accordance with the preferred embodiment of the present invention.

FIG. **8** is a schematic view of a printed circuit board applied in the present invention.

FIG. **9** is a schematic view of a complete-assembled motor stator manufactured by the motor stator automatically assembling system and method in accordance with the preferred embodiment of the present invention.

FIGS. **10** and **11** are schematic views of an outer stator ring frame and pole tooth units applied in a DC three-phase motor structure or an AC three-phase motor structure in accordance with the preferred embodiment of the present invention.

FIG. **12** is a schematic view of the pole tooth units combined with isolation jackets applied in the present invention.

FIG. **13** is a schematic view of the pole tooth units engaged with the outer stator ring frame applied in the present invention.

FIGS. **14** and **15** are schematic views of a printed circuit board and an inner rotor core applied in the present invention.

FIG. **16** is a schematic view of a sectional stator of the present invention.

FIG. **17** is a sectional view of the three-phase motor structure of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

It is noted that a motor stator automatically assembling system and method in accordance with the preferred embodiment of the present invention is suitable for assembling and testing various motor stator steps, for example: inner or outer stator assembling steps, which are not limitative of the present invention. The motor stator automatically assembling system and method in accordance with the preferred embodiment of the present invention is suitably implemented by utilizing various automatic apparatus, for example: auto pin insert machines, auto conveyers, auto wire-winding machines, auto

punch machines, auto testing equipments and combination thereof, which are not limitative of the present invention.

Referring to FIGS. **1**, **1**A, **2**A and **2**B, the motor stator automatically assembling method, as shown in FIG. **1**, in accordance with a preferred embodiment of the present invention includes eight steps corresponding to the motor stator automatically assembling system, as best shown in FIGS. **2**A and **2**B, or the assembly line, as best shown in FIG. **1**A. Turning now to FIG. **3**, an isolation member or the like (e.g. isolation jacket or bobbin member) is applied to execute an automatically assembling method in accordance with the present invention.

Referring to FIGS. **1**, **2**A and **3**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**1**: automatically inserting at least one pin **101** in each predetermined side position of insulation members (e.g. isolation jacket) **10** by a pin insert unit (e.g. pin insert machine) **1**, thereby automatically supplying the insulation members **10** therefrom. Each of the insulation members **10** has a central hole and a wire-winding recess formed therearound, as best shown in FIG. **3**.

Still referring to FIGS. **1**, **2**A and **3**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**2**: automatically selecting and feeding the insulation members **10** by a feeder unit (e.g. feeder machine) **2** and a vibrator unit (e.g. vibrator machine) **2***a* connected therewith, thereby feeding the insulation members **10** into an assembly line and selecting the unqualified insulation members **10**. The insulation members **10** received from the pin insert unit **1** are automatically conveyed by the feeder unit **2** to the vibrator unit **2***a*.

With continued reference to FIGS. **1**, **2**A and **3**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**3**: automatically supplying and arranging the insulation members **10** in order on a first conveyer unit (e.g. a pair of automatically reciprocated slides) **3** which is operated to automatically convey the insulation members **10** from the pin insert unit **1** or the vibrator unit **2***a* to an auto wire-winding unit (e.g. multi-winding machine) **4**. By way of example, the insulation members **10** are automatically arranged in order on positioning seats of the first conveyer unit **3** and are further conveyed along a track to a predetermined position (e.g. the auto wire-winding unit **4**) so as to process a procedure of wire-winding, soldering, testing and other processing.

FIG. **4** shows a schematic view of the wire-wound insulation member manufactured by the motor stator automatically assembling system and method, as best shown in FIGS. **1** and **2**A, in accordance with the preferred embodiment of the present invention. Referring to FIGS. **1**, **2**A, **3** and **4**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**4**: automatically winding wires **102** on the wire-winding recesses of the associated insulation members **10** to form a plurality of wire-wound insulation members **10** with windings by the wire-winding unit **4**. By way of example, a wire array seat **4***a* is provided with the wire-winding unit **4** to supply a plurality of the wires **102** thereto for wire-winding operation.

With continued reference to FIGS. **1**, **2**A, **3** and **4**, by way of example, while or after automatically winding the wires **102** on the insulation members **10**, the wires **102** are further automatically wound on the associated pin **101** to electrically connect therewith. Accordingly, the entire wire-winding process shall be simplified by reducing a separate wire-winding or binding process of the wire **102** with the pin **101**.

Turning now to FIGS. **2**A and **2**B, by way of example, the wire-wound insulation members **10** are automatically extracted from the wire-winding unit **4**, as best shown in FIG. **2**A, are arranged in order on positioning seats of a second conveyer unit **3'** (or rearranged on the first conveyer unit **3**) and are further conveyed along the track to a first testing equipment **5** or a predetermined position (e.g. auto soldering unit) so as to process a procedure of solder-paste-wetting, soldering or pin-bending. The first testing equipment **5** is used to execute an impedance or insulation test on the wire-wound insulation members **10**.

Referring again to FIGS. **1**, **2**B and **4**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**5**: automatically supplying and arranging the wire-wound insulation members **10** on a third conveyer unit (e.g. conveyer belt) **6** which is operated to convey the wire-wound insulation members **10** to a first assembly unit **6***a* and a second assembly unit **7**. By way of example, the wire-wound insulation members **10** are automatically extracted from the first testing equipment **5** by a manipulator unit **5***a* and are further deployed on the third conveyer unit **6** by an air piston. The third conveyer unit **6** further includes a vibrator unit operated to convey the wire-wound insulation members **10**.

FIGS. **5** and **5***a* are schematic views of compact pole tooth sets and stacked pole teeth provided in a feed magazine applied in the present invention. Referring to FIGS. **1**, **2**B, **5** and **5***a*, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**6**: automatically inserting a single pole tooth or stacked pole teeth **201** into the central holes of the wire-wound insulation members **10** in a manner of fitting to form a plurality of the compact pole tooth sets **10** by the first assembly unit **6***a*. Accordingly, after assembled, the compact pole tooth sets **10** are applied to generate magnetic fields to electrically drive a motor rotor, not shown in drawings. By way of example, each of the pole teeth **201** has a pole pillar, an engaging portion and a pole face, as best shown in FIG. **5***a*.

Referring again to FIGS. **1**, **2**B, **5** and **5***a*, by way of example, the first assembly unit **6***a* has eight or more sets of pole tooth storage units (e.g. feed magazine with magazine spring) **202** which are arranged in a circular member of the first assembly unit **6***a*. Each set has four pole tooth storage units **202** which are equi-spaced apart, as best shown in FIG. **2**B. In assembling operation, the pole teeth **201** are fittingly inserted into the central holes of the wire-wound insulation members **10**.

FIG. **6** shows a schematic view of a stator ring frame applied in the present invention corresponding to stator ring frames **20** shown in FIG. **2**B. FIG. **7** shows a schematic view of a semi-assembled motor stator formed by the stator ring frame, as best shown in FIG. **6**, in accordance with the preferred embodiment of the present invention. Referring again to FIGS. **1**, **2**B, **6** and **7**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention includes the step S**7**: automatically inserting at least one or a plurality of the compact pole tooth sets **10** into the stator ring frame **20** to form a semi-assembled motor stator **100** by the second assembly unit **7**. By way of example, the third conveyer unit **6** is provided to convey the compact pole tooth sets **10** to the second assembly unit **7** or is selectively omitted.

With continued reference to FIG. **6**, by way of example, the stator ring frame **20** can be selected from an outer stator ring

frame or an inner stator ring frame. Furthermore, the second assembly unit **7** includes a fourth conveyer unit **7***a* which is operated to convey the stator ring frame **20** to the second assembly unit **7** or may be omitted. The second assembly unit **7** includes a rotary server unit (e.g. 12-station rotary server unit) which is applied to rotate the stator ring frame **20** for inserting each of the compact pole tooth sets **10** into engaging portions of the stator ring frame **20**.

Referring again to FIGS. **2**B and **7**, by way of example, the motor stator automatically assembling method in accordance with the alternative embodiment of the present invention further includes the step: automatically punching at least one surface of the semi-assembled motor stator **100** by a punch machine **8** to form a plurality of recessions "A" which are formed to combine the pole teeth **201** each other or to combine the compact pole tooth sets **10** with the stator ring frame **20** so as to reinforce the structure of the semi-assembled motor stator **100**. The punch machine **8** further includes a rotary unit (e.g. manipulator) **8***a* which is applied to turn the semi-assembled motor stator **100** over for punching operation.

FIG. **8** shows a schematic view of a printed circuit board **30** attached to a side of the semi-assembled motor stator **100** shown in FIG. **7**. FIG. **9** shows a schematic view of the printed circuit board **30**, as best shown in FIG. **8**, attached to a side of the semi-assembled motor stator **100**, as best shown in FIG. **7**, to form a complete-assembled motor stator in accordance with the preferred embodiment of the present invention. Referring again to FIGS. **1**, **2**B, **8** and **9**, the motor stator automatically assembling method in accordance with the preferred embodiment of the present invention further includes the step S**8**: automatically combining the printed circuit board **30** with the semi-assembled motor stator **100** by an auto holder unit (e.g. manipulator) **9***a* to form a complete-assembled motor stator. In a preferred embodiment, the pins **101** of the semi-assembled motor stator **100**, as best shown in FIG. **3**, are inserted into via holes of the printed circuit board **30**, and the pins are further bent and moistened with solder paste for soldering the semi-assembled motor stator **100** with the printed circuit board **30**. By way of example, the printed circuit board **30** includes a plurality of contact points, including a first phase (U phase) contact point **30***a*, a second phase (V phase) contact point **30***b* and a third phase (W phase) contact point **30***c*. In order to improve the assembling operation, the contact points of U, V and W phases are provided with assembly marks shown at "U", "V" and "W" on the printed circuit board **30** for perfect alignment.

Referring again to FIGS. **1**, **2**B and **9**, the motor stator automatically assembling method in accordance with the alternative embodiment of the present invention further includes the step: automatically executing a power test, a resistance test, a dielectric withstand voltage test, an insulation shock test or a load test on the complete-assembled motor stator **100** by a second test equipment **9***b*. Accordingly, the complete-assembled motor stators **100** are separated into two lines on which to convey qualified stator products and unqualified stator products.

Referring again to FIGS. **2**A and **2**B, the motor stator automatically assembling system in accordance with the preferred embodiment of the present invention selectively includes the pin insert unit **1**, the feeder unit **2**, the wire-winding unit **4**, the first assembly unit **6***a* and the second assembly unit **7**. In an alternative embodiment, the motor stator automatically assembling system further includes the vibrator unit **2***a*, the first conveyer unit **3**, the second conveyer unit **3'**, the third conveyer unit **4**, the fourth conveyer unit **7***a*, the punch unit **8**, the rotary unit **8***a*, the first testing equipment **5**, the second testing equipment **9***b*, the auto holder unit **9***a* or other equipments.

With continued reference to FIGS. **2**A and **2**B, the first conveyer unit **3** connects to the feeder unit **2** and the wire-winding unit **4** connects to the first conveyer unit **3**. Furthermore, the second conveyer unit **3'** connects to the wire-winding unit **4** and the first assembly unit **6***a* connects to the second conveyer unit **7** so as to form an assembly line.

Referring to FIGS. **10** and **11**, the three-phase motor structure includes a sectional stator **100***a* having an outer stator ring frame **11** and a series of pole tooth units **12**. The outer stator ring frame **11** and the pole tooth units **12** are made of magnetically conductive materials or other similar materials, for example: silicon steel plates. The outer stator ring frame **11** has an inner circumferential flange (dotted line in FIG. **10**) surrounding a longitudinal axis to form an axial hole. The inner flange of the outer stator ring frame **11** corresponds to the pole tooth units **12** so that the outer stator ring frame **11** and the pole tooth units **12** are assembled to form the sectional stator **100***a*.

Turning now to FIGS. **11** and **12**, the pole tooth units **12** are detachable from the outer stator ring frame **11** for disassembly and include a plurality of pole teeth, for example: 9 pole teeth. When assembled, the pole tooth units **12** are deployed along the inner flange of the outer stator ring frame **11** and are equi-spaced apart. Each of the pole tooth units **12** has an outer flange (dotted line in FIG. **11**) located on the pole tooth. The outer flange of the pole tooth unit **12** corresponds to the inner flange of the outer stator ring frame **11**. Furthermore, each pole tooth of the pole tooth units **12** has an inner pole face with respect to the longitudinal axis.

With continued reference to FIGS. **11** and **12**, the pole tooth units **12** include an isolation device **121** and a winding set **122**, and the isolation device **121** is provided between the winding set **122** and the pole teeth. In addition, the isolation device **121** includes a plurality of isolation jackets while the winding set **122** includes a plurality of wire windings and a plurality of wire connection ends, as best shown in FIG. **12**, such that each pole tooth is provided with at least one isolation jacket and at least one wire winding. Prior to assembling or reassembling the sectional stator **100***a*, the winding set **122** is wound on each pole teeth of the pole tooth units **12** by a wire winding machine and subsequently the isolation device **121** is further formed on the pole tooth units **12** so as to speed the wire winding process (entire assembling or reassembling process).

Turning now to FIGS. **10** through **13**, in assembling or reassembling, each outer flange of the pole tooth units **12** is correspondingly engaged with the inner flange of the outer stator ring frame **11** by magnetic conductive materials (paste), for example. The outer stator ring frame **11** includes at least one first engaging portion **110** while the pole tooth units **12** include at least one second engaging portion **120** to engage with the first engaging portion **110**. Preferably, the first engaging portion **110** is provided on the inner flange of the outer stator ring frame **11**, and the second engaging portion **120** is provided on the outer flanges of the pole tooth units **12**.

Referring again to FIGS. **10** and **13**, the first engaging portion **110** is selected from a recession while the second engaging portion **120** is selected from a protrusion. In an alternative embodiment, the first engaging portion **110** is selected from a protrusion while the second engaging portion **120** is selected from a recession.

Turning now FIG. **14**, the three-phase motor structure further includes a printed circuit board **30** including a plurality of

contact points to correspondingly connect with the wire connection ends of the winding set **122**. By way of example, the contact points include a first phase (U phase) contact point **30***a*, a second phase (V phase) contact point **30***b* and a third phase (W phase) contact point **30***c*. In assembling or reassembling, the contact points are correspondingly connected with the wire connection ends of the winding set **122** by welding, for example.

Turning now FIG. **15**, the three-phase motor structure further includes an inner rotor core **300** comprised of a rotor **31** and a magnet **32**. In assembling or reassembling, the inner rotor core **300** extends through the sectional stator **100***a* such that the inner pole faces of the pole tooth units **12** correspond to the magnet **32** for driving the motor.

Turning now FIG. **16**, after assembled the sectional stator **100***a*, the printed circuit board **30** is further attached to a side of the sectional stator **100***a* and electrically connects therewith. In order to improve the assembling or reassembling operation, the contact points of U, V and W phases are provided with assembling marks shown at "U", "V" and "W" on the printed circuit board **30** for perfect alignment.

Turning now FIG. **17**, the combined structure of the stator **100***a*, the printed circuit board **30** and the inner rotor core **300** is provided in a housing **4**. When the stator **100***a* is operated to drive the inner rotor core **300**, an axis **40** combined with the inner rotor core **300** rotates synchronously. The housing **4** can be achieved in the known manner so that the detailed descriptions may be omitted.

Although the invention has been described in detail with reference to its presently preferred embodiment(s), it will be understood by one of ordinary skill in the art that various modifications can be made without departing from the spirit and the scope of the invention, as set forth in the appended claims.

What is claimed is:

1. A motor stator automatically assembling method comprising:

feeding insulation members by a feeder unit;

supplying and arranging the insulation members on a first conveyer unit which conveys the insulation members to a wire-winding unit;

winding wires on the associated insulation members to form wire-wound insulation members by the wire-winding unit;

supplying and arranging the wire-wound insulation members on a second conveyer unit which conveys the wire-wound insulation members to a first assembly unit;

inserting pole teeth into the wire-wound insulation members to form a plurality of compact pole tooth sets by the first assembly unit; and

inserting the compact pole tooth sets into a predetermined stator ring frame to form a semi-assembled motor stator by a second assembly unit.

2. The motor stator automatically assembling method as defined in claim **1**, wherein selecting the insulation members by a vibrator unit while feeding the insulation members.

3. The motor stator automatically assembling method as defined in claim **1**, wherein prior to selecting and feeding the insulation members, inserting at least one pin in the insulation member by a pin insert unit.

4. The motor stator automatically assembling method as defined in claim **3**, wherein while winding the wires on the insulation members, further winding the wires on the associated pin to electrically connect therewith.

5. The motor stator automatically assembling method as defined in claim **3**, wherein bending the pin of the wire-wound insulation members to form a bent portion.

6. The motor stator automatically assembling method as defined in claim **1**, wherein executing an impedance or insulation test on the wire-wound insulation members by a test equipment.

7. The motor stator automatically assembling method as defined in claim **1**, wherein the pole teeth are provided in a feed magazine from which to insert the stacked pole teeth into the wire-wound insulation members.

8. The motor stator automatically assembling method as defined in claim **1**, wherein supplying the stator ring frame to the second assembly unit by a third conveyer unit.

9. The motor stator automatically assembling method as defined in claim **1**, wherein rotating the stator ring frame with respect to the second assembly unit by a rotary unit, thereby inserting each of the pole tooth sets into the stator ring frame.

10. The motor stator automatically assembling method as defined in claim **1**, wherein combining a printed circuit board with the semi-assembled motor stator to form a complete-assembled motor stator.

11. The motor stator automatically assembling method as defined in claim **1**, wherein punching at least one surface of the semi-assembled motor stator to form at least one recession which is formed to combine the pole teeth each other or to combine the pole tooth sets with the stator ring frame.

12. The motor stator automatically assembling method as defined in claim **1**, wherein executing a power test, a resistance test, a dielectric withstand voltage test, an insulation shock test or a load test on the motor stator by a test equipment.

13. A motor stator automatically assembling system comprising:

a feeder unit provided to feed a plurality of insulation members;

a first conveyer unit connecting to the feeder unit to receive the insulation members therefrom, the first conveyer unit operated to arrange the insulation members thereon and to convey the insulation members from the feeder unit;

a wire-winding unit connecting to the first conveyer unit to receive the insulation members therefrom, the wire-winding unit operated to wind wires on the insulation members to form a plurality of wire-wound insulation members;

a second conveyer unit connecting to the wire-winding unit to receive the wire-wound insulation members therefrom, the second conveyer unit operated to arrange the wire-wound insulation members thereon and to convey the wire-wound insulation members from the wire-winding unit;

a first assembly unit connecting to the second conveyer unit to receive the wire-wound insulation members therefrom, the first assembly unit operated to insert pole teeth into the wire-wound insulation members to form a plurality of compact pole tooth sets; and

a second assembly unit operated to insert the compact pole tooth sets into a predetermined stator ring frame to form a semi-assembled motor stator.

14. The motor stator automatically assembling system as defined in claim **13**, wherein the feeder unit further includes a vibrator unit which is operated to select the insulation members prior to feeding.

15. The motor stator automatically assembling system as defined in claim **13**, further including a pin insert unit which is operated to insert at least one pin in the insulation member.

16. The motor stator automatically assembling system as defined in claim **13**, further including a third conveyer unit connected between the first assembly unit and the second

assembly unit, the third conveyer unit operated to convey the compact pole tooth sets to the second assembly unit.

17. The motor stator automatically assembling system as defined in claim **13**, further including a fourth conveyer unit which is operated to convey the stator ring frame to the second assembly unit.

18. The motor stator automatically assembling system as defined in claim **13**, wherein the pole teeth are provided in a feed magazine from which to insert the stacked pole teeth into the wire-wound insulation members.

19. The motor stator automatically assembling system as defined in claim **13**, wherein a rotary unit is provided to rotate the stator ring frame with respect to the second assembly unit, thereby inserting each of the pole tooth sets into the stator ring frame.

20. The motor stator automatically assembling system as defined in claim **13**, wherein a holder unit is provided to hold the printed circuit board in combining with the semi-assembled motor stator to form a complete-assembled motor stator.

* * * * *